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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/772,153	02/04/2004	Shilin Chen	SC-03-01	1857

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EXAMINER	
FERRIS III, FRED O	

ART UNIT	PAPER NUMBER
2128	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/772,153	CHEN, SHILIN	
	Examiner	Art Unit	
	Fred Ferris	2128	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *24 May 2007*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-39* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-39* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *04 February 2004* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

1. Claims 1-39 have been presented for examination based on applicant's amendment filed 24 May 2007. Claims 1-39 are currently pending in this application and stand rejected by the examiner.

Response to Arguments

2. Applicant's arguments filed 24 May 2007 have been fully considered.

Response to 112(1): Since, as argued, the elements of "simulating operation of drill bit through a formation" are known to one skilled in the art, and are indeed disclosed in the Ma reference, the examiner withdraws the 112(1) rejection.

Response to 112(2): The 112(2) rejection for the recited method of drilling is now withdrawn in view of the new 112(1) rejection cited below. The 112(2) rejection claims 9-16, and 25-32 is withdrawn if view of amendment to the claims.

Response to 101: Withdrawn if view of amendment to the claims.

Response to 103(a): Applicants appear to argue that, while known at the time of the invention, the specification does not disclose a substantial teaching of multiobjective optimization. The previous rejection is therefor withdrawn. However, multiobjective optimization problems can be found in various fields: product and process design, finance, aircraft design, the oil and gas industry, automobile design, or wherever optimal decisions need to be taken in the presence of trade-offs between two conflicting objectives. Hence, any skilled artisan would have been aware of the advantages of using multiobjective optimization in the design process in order to optimize the roller

cone bit design. New rejections are now given in view of Deb. (See new 103 rejections below)

Claim Rejections - 35 USC § 112

The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

3. Claims 8, 16, 24, 32 and 39 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the enablement requirement.

The claim(s) contains subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention.

*Specifically, claims 8, 16, 24, 32 and 39 recite the limitation "method of drilling" in independent claims 1, 9, 17, 25, and 33 respectively which are drawn to a method of designing roller-cone drill bits by optimization. There does not appear to be any basis for support of the limitations relating to a **method for drilling** in the specification. The specification appears to deal entirely with methods for designing roller cone bits inclusive of simulated drilling, but appears to be completely silent on any actual method for real world drilling using the disclosed design.*

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. Claims 1-39 are rejected under 35 U.S.C. 103(a) as being unpatentable over "The Operational Mechanics of The Rock Bit", Ma et al, Petroleum Industry Press, Copyright 1996 (of record) in view of Evolutionary Algorithms for Multi-Criteria Optimization in Engineering Design, Deb, University of Dortmund, 1999.

Per independent claims 1, 9, 17, and 25: Ma et al discloses techniques for optimizing the design of a roller bit (chapter 6) drilling a simulated earth formation (chapter 5), the operational mechanics (e.g. design parameters) of roller bit geometry and cutting elements (chapter 2, 6.1), the kinematics of the bit (teeth, rollers, scraping formation, etc. chapter 3), rock and bit iteration (volume, etc. chapter 5), and bit design and force analysis (optimize using computer simulation by size, load, motion, stress, etc. chapter 6, section 5.4, especially page 232, based on the entire teachings).

While Ma does teach optimization of roller-cone drill bit design by considering the effects of multiple design parameters, Ma is silent on the specific use of multi-objective optimization.

However, prior art Deb teaches multi-objective optimization techniques known in the engineering art (such as disclosed by: Gembicki, 1974, Grace, 1989), including

Weighted Sum Method (Section 1.3.1), the Single Objective Method (Section 1.2) and the Goal Attainment Method (Section 1.1)

It would have been obvious to one having ordinary skill in the art at the time the claimed invention was made to modify the teachings of Ma relating to optimizing the design of a roller bit, drilling a simulated earth formation, and the operational bit mechanics parameter, with the teachings of Deb specifically relating to multi-objective optimization techniques as known in the engineering art (such as disclosed by: Gembicki, 1974, Grace, 1989), to realize the claimed invention. An obvious motivation exists since, in this case, and as recognized by applicants, multi-objective optimization permits various (design) factors to be taken into account in a balanced way and simplifies the overall complicated roller-cone bit design process.

Further, multiobjective optimization problems can be found in various fields: product and process design, finance, aircraft design, the oil and gas industry, automobile design, or wherever optimal decisions need to be taken in the presence of trade-offs between two conflicting objectives. Hence, any skilled artisan would have been aware of the advantages of using multiobjective optimization in the design process in order to optimize the roller cone bit design.

Accordingly, a skilled artisan having access to the teachings of Ma and the multi-objective techniques of Deb, would have knowingly modified the teachings of Ma with the teachings of Deb (or visa versa) to realize the claimed elements of the present invention and thereby simplify the overall complicated roller-cone bit design process.

Per dependent claims 2-6, 10-14, 18-22, 26-30: Ma sets forth maximizing penetration rate (roller cone penetration Chapters 2-5, Section 6.1) by design, bit (shock) loading (5.4, especially page 232) on components, distance of cutting teeth (Ma discloses contacting teeth effects, page 95, paragraph 1) and the importance of balancing forces ob bit components (3.3). (e.g. Ma sets forth a model to find the "optimum" set of design parameters, and that the bit energy should be in balance 3.3, as well as the load distribution to parts (e.g. rollers), 6.2.1))

Per claims 7, 8, 15, 16, 23, 24, 31, 32, 38, 39: Ma discloses bit designs and drilling resulting from an optimization of design parameters (Chapters 2, 3, 5 and 6, Fig. 2-1).

Regarding independent claim 33: Claim 33 includes limitations related to reading initial optimization information (e.g. parameters) and simulating drilling a formation which are rendered obvious in view of Ma as cited above (i.e. optimizing the design of a roller bit (chapter 6) drilling a simulated earth formation (chapter 5), the operational mechanics (e.g. design parameters) of roller bit geometry and cutting elements (chapter 2, 6.1)) The generation of design constraints and bound (limitations) would further be obvious in view of Ma's new method teaching for optimizing design performance parameters disclosed in sections 6.1.1, 6.1.2, and 6.2. Ma further teaches both 2D and 3D bit interactions models (chapters 2, 3, 6, especially 2.2, 3.1) As also cited above, multi-objective optimization techniques were known in the engineering art at the time of the invention, and hence would have been knowingly combined by a skilled artisan to

realize an "algorithm for optimization" using the same reasoning previously set forth above.

Regarding claims 34-37: Ma teaches the effects of tooth length and range including orientation angle and clearance (2.2, 3.1) and the resulting effects on formation cutting (Sections 3.3 - 3.5, pages 94-105, Figs. 3-10, 3-11).

Conclusion

5. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure, careful consideration should be given prior to applicant's response to this Office Action.

"Design Considerations for a Hard-Rock PDC Drill Bit, Glowka, SAND-85-066C, OSTI 1985 teaches optimizing design of roller-cone drill bits.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Fred Ferris whose telephone number is 571-272-3778 and whose normal working hours are 8:30am to 5:00pm Monday to Friday. Any inquiry of a general nature relating to the status of this application should be directed to the group receptionist whose telephone number is 571-272-3700. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Kamini Shah can be reached at 571-272-2279. The Official Fax Number is: (571) 273 8300

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